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Migration and Detection of Gas in Geological Media: Lessons Learned from the Roselend Natural Laboratory

The Roselend Natural Laboratory (French Alps) is a unique facility for studying gas transport in the subsurface and across the geosphere-atmosphere interface. At 55 m depth, a sealed cavity allows for gas release experiments across fractured porous rocks in the unsaturated zone. While many parameters describing the state of the geological system are controlled, analogous gas-tracer experiments were conducted at the field-scale with SF6, freon and 3He. Water infiltration, permeability and the concentrations of many gases, naturally occurring or injected, are recorded via long-term and high-resolution monitoring. The fracture network was characterized through extensive drilling and modeling. These experiments are used to determine the physical and chemical processes that would control the noble gas source term after an underground nuclear explosion, and to develop and validate the corresponding numerical models. The Roselend Natural Laboratory also provides a test bed for sampling protocols and instrument developments. Detection of gases relevant to CTBT issues requires that their baseline concentration is understood. Experiments and subsequent modeling demonstrated that baselines are a highly dynamical process resulting from gas sources, sinks and modulation by barometric pressure. Transient gas concentration anomalies, up to 2 orders of magnitude, commonly result from water movements amplified in fracture networks.

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